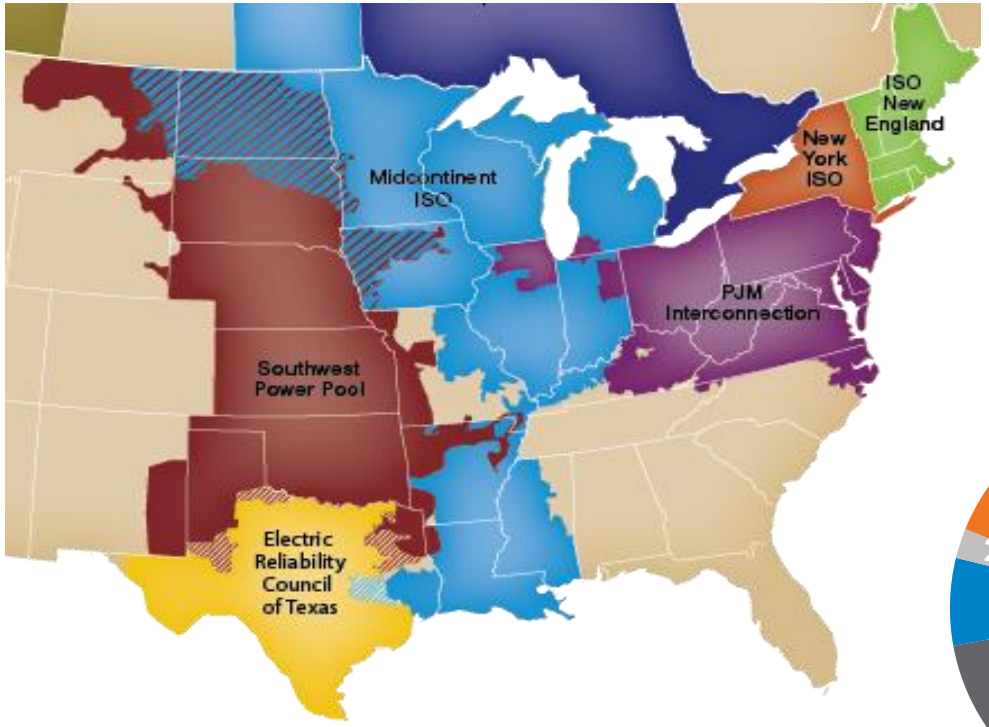
MISO Updates – Reliability, Transmission, and EPA Regulations

North Dakota Legislative Assembly

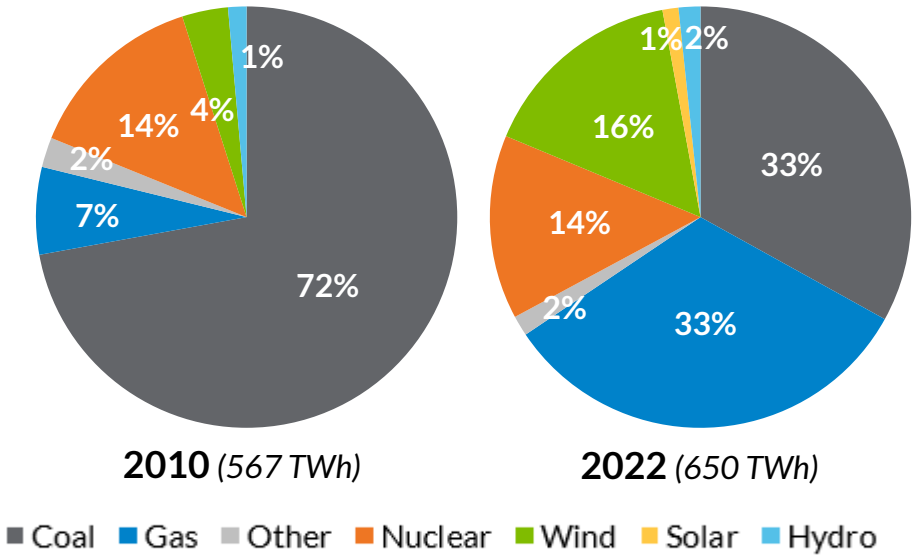
August 7, 2023

MISO drives value creation through efficient and reliable markets, operations, planning, and innovation



- Service area includes portions of 15 states and the Canadian province of Manitoba
- Approximately 45 million customers
- 72,000 miles of transmission including Manitoba
- Record demand: 127.1 GW *(July 2011)*
- Max wind peak: 24.1 GW *(November 2022)*
- Max solar peak: 2.2 GW *(August 2022)*

Generation Mix



Grid Reliability

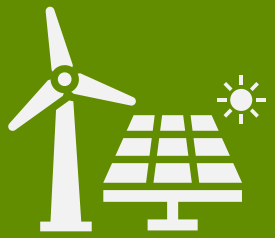
MISO's resource adequacy construct is evolving to ensure continued reliability under a changing risk profile driven by the resource fleet transition

- Aggressive decarbonization strategies by some MISO utilities and states are driving rapid change across our region
- Pace of change highlights the need for improved visibility & coordination between MISO and stakeholders
- MISO is advancing initiatives to reliably navigate from the present to the future
  - Seasonal resource adequacy construct
  - Reliability-based demand curve
  - Non-thermal resource accreditation & attributes

Transformation is progressing at an astonishing pace and will speed up over the next several years

Fleet Changes

MISO members and states have set ambitious goals to partially or fully decarbonize



Fuel Assurance

Availability of resources may be challenged by economic, supply chain or other issues

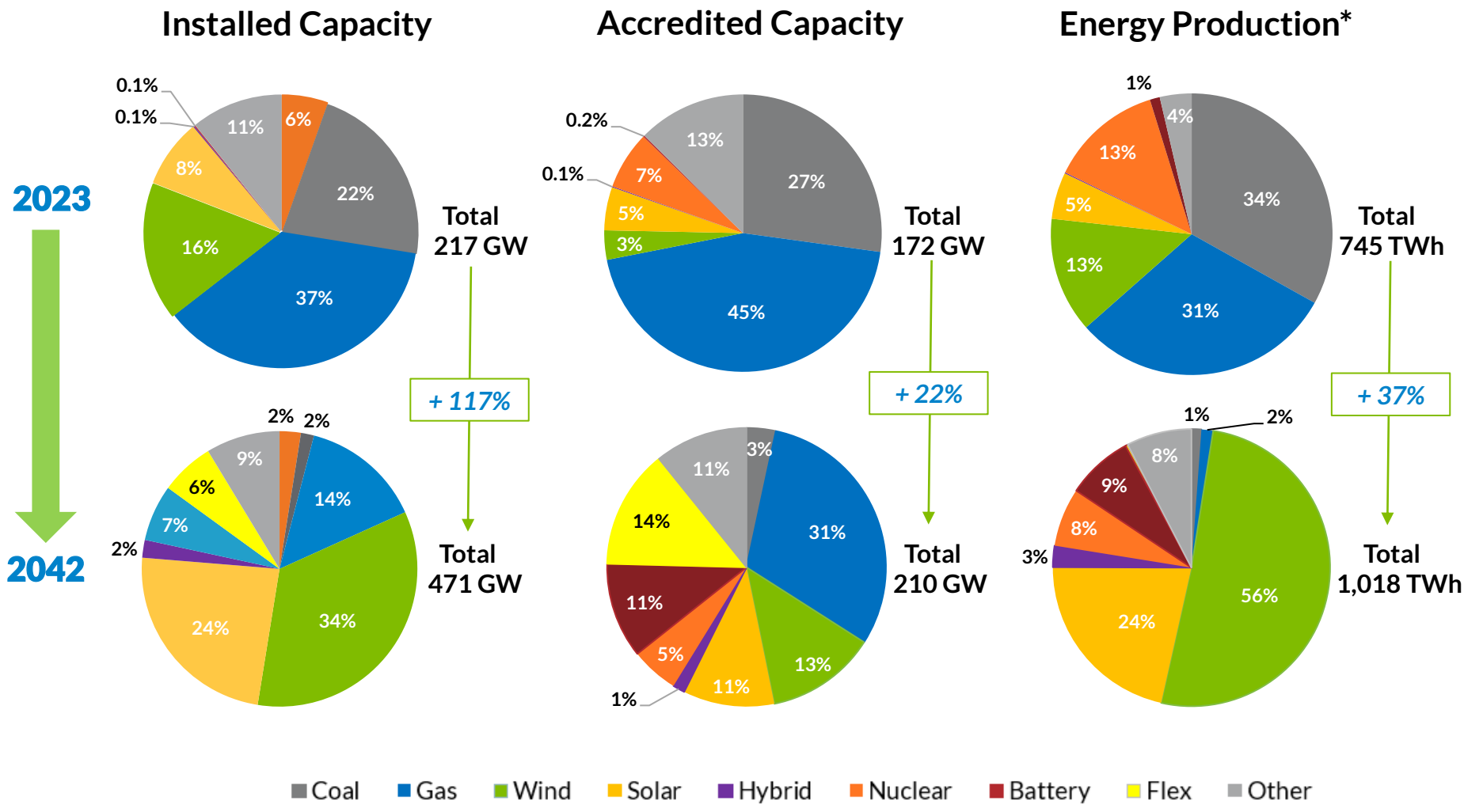
Extreme Weather

Severe weather events are becoming more extreme and occurring more frequently

Electrification

Demand for electricity will grow as electric vehicles increase, industry sectors trend towards renewables

MISO's Future 2A anticipates significant resource additions, retirements and load growth with a trend towards increasing renewables



Data updated July 10, 2023. *Futures do not account for all operational-level reliability needs and attributes that may require different levels of resources. Resource additions may be subject to adjustment based on new accreditation rules. "Other" includes biomass, geothermal, hydro, oil, pumped hydro, demand response, and non-pv distributed generation (and energy efficiency for installed capacity). *Pie chart is greater than 100% due to energy storage charging and discharging.*

MISO's Reliability Imperative guides the transformation needed to maintain reliability for the grid of the future

Market Redefinition

Develops significant market enhancements and optimizations to ensure continued reliability and value in anticipation of the changing resource mix, more frequent extreme weather events, and increasing electrification

Transmission Evolution

Assesses the region's future transmission needs and associated cost allocation holistically, including transmission to support utility and state plans for existing and future generation resources

Operations of the Future

Focuses on the skills, processes and technologies needed to ensure MISO can effectively manage the grid of the future under increased complexity

System Enhancements

Creates flexible, upgradeable, and secure systems that integrate advanced technologies to process increasingly complex information and evolve with the industry

MISO Reliability Imperative (misoenergy.org)

Higher variability and complexity have significant implications for reliability and energy adequacy in the region

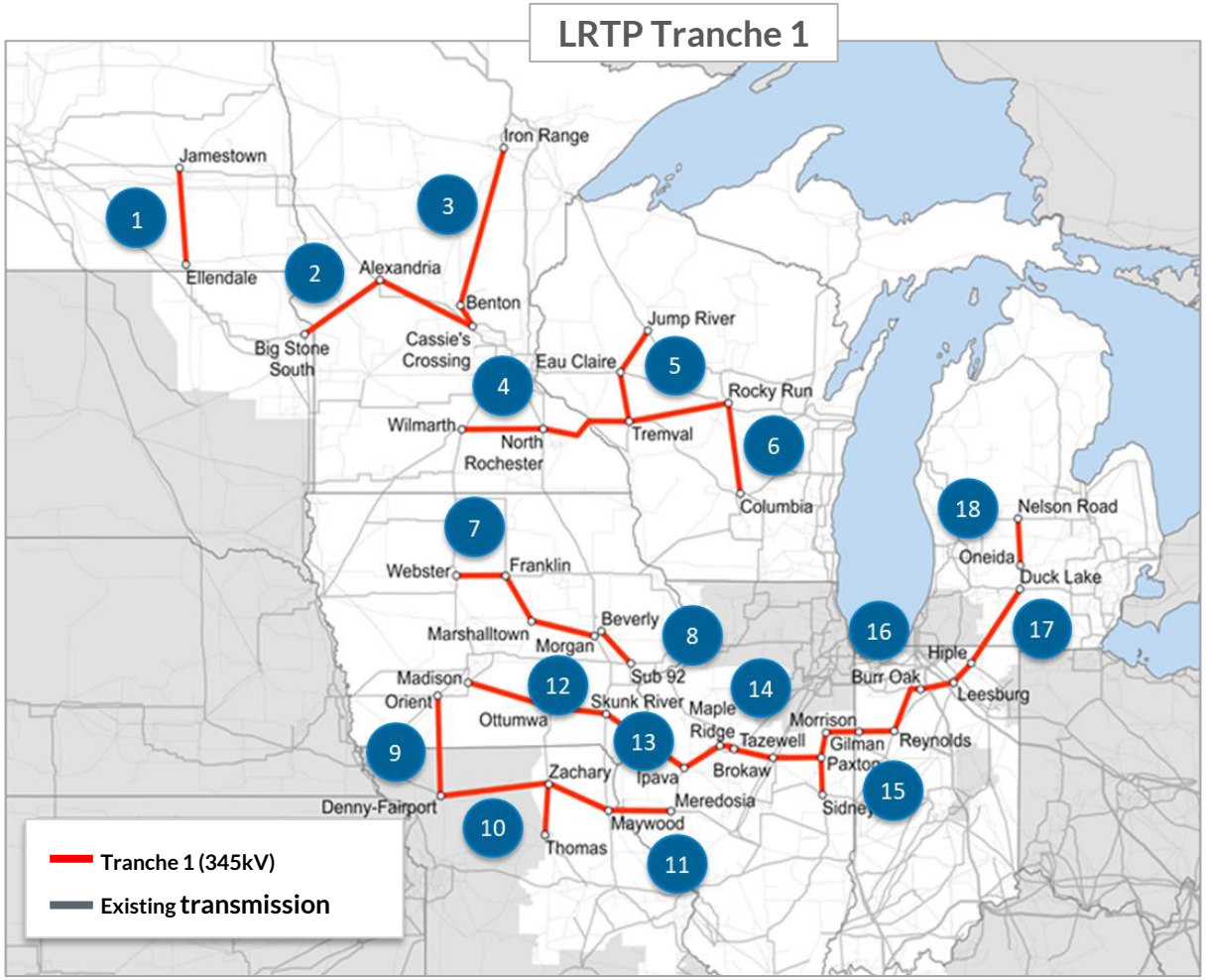
	PAST	PRESENT	FUTURE
RISK EVALUATION	• Capacity planned for single peak hour using 1-in-10 standard	• Seasonal resource adequacy • Energy adequacy in all hours • Extreme weather	• Expected unserved energy; days/ weeks • Adequacy of key reliability attributes
MARKET EVOLUTION	• Energy • Capacity • Ancillary services	• Seasonal accreditation • Pricing/incentive • Attribute definition • Seams coordination	• Hourly energy adequacy • Accreditation of attributes • Fuel assurance • Seams optimization
TOOL ENHANCEMENT FOCUS	• Regional load and weather forecasting • System efficiency	• Extend visibility horizon • Variable generation and weather forecasting • Coordination with fuel suppliers and neighbors	• Uncertainty management; artificial intelligence • Granular weather forecasting • Retail/wholesale coordination

Additional efforts and developments are addressing resource adequacy

Effort/Development	Impact
Improved resource accreditation	Aligns resource capabilities and accredited resource value with needs during the highest risk hours across the year
FERC unit retirement process reforms (Attachment Y)	Provides longer-term view and preparation
Regional Resource Assessment and OMS-MISO survey enhancements	Improves visibility on needs and gaps with both near- and longer-term view
Identify and quantify necessary resource attributes	Ensures reliability with rapid retirements of legacy resources and future with significant renewable resources and emerging technologies
Long Range Transmission Planning Tranche 1 approval	Enables lower interconnection costs and facilitates Member plans
The Inflation Reduction Act approval	Extends tax credits and provides additional incentives for resource development

Transmission Expansion in North Dakota

Tranche 1 represents the first iteration and includes 18 projects across the MISO Midwest subregion estimated at $10.3 billion

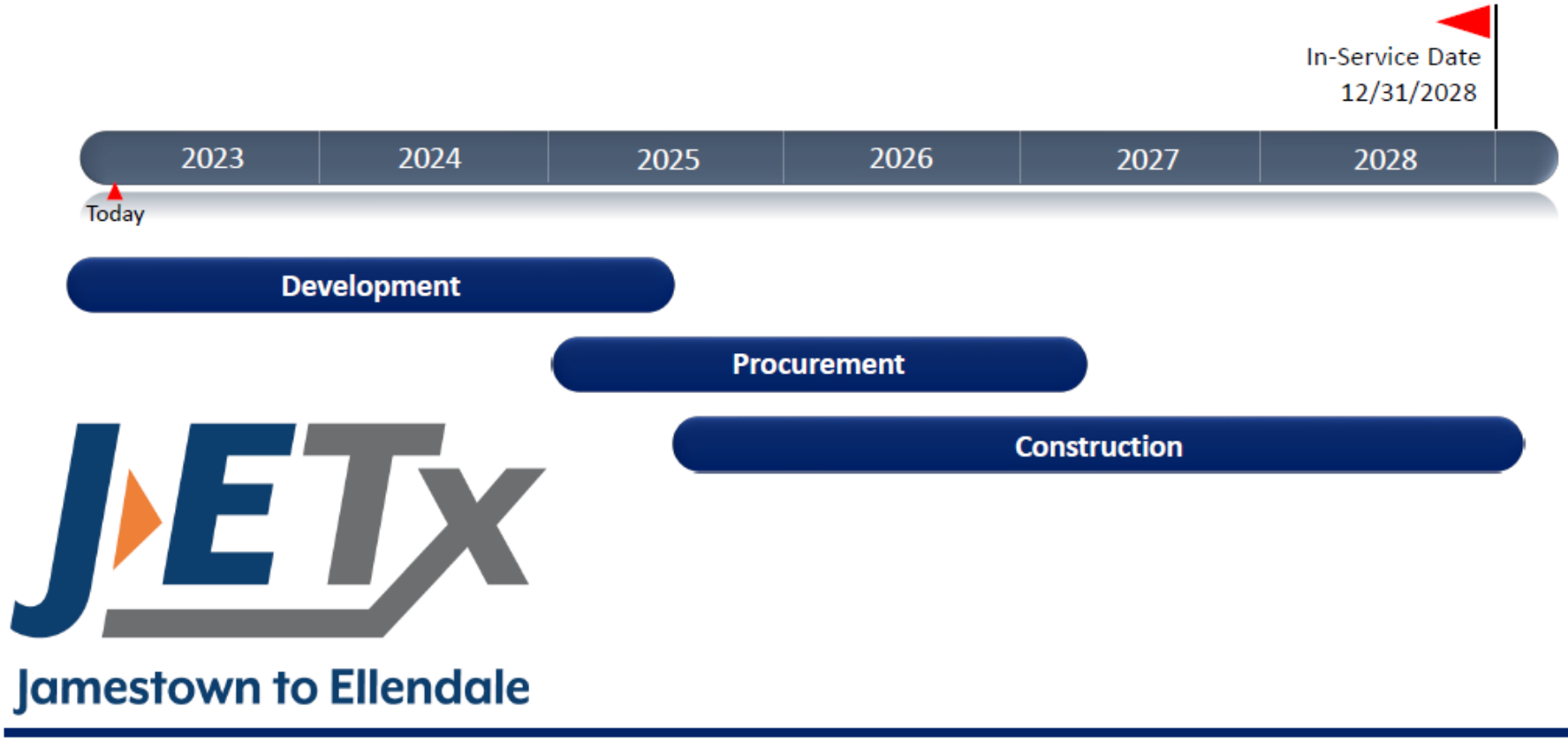


Assumption on all in-service dates is by 2030

ID	Project Description	Est. Cost ($M, 2022)
1	Jamestown – Ellendale	$439M
2	Big Stone South – Alexandria – Cassie's Crossing	$574M
3	Iron Range – Benton County – Cassie's Crossing	$970M
4	Wilmarth – North Rochester – Tremval	$689M
5	Tremval – Eau Clair – Jump River	$505M
6	Tremval – Rocky Run – Columbia	$1,050M
7	Webster – Franklin – Marshalltown – Morgan Valley	$755M
8	Beverly – Sub 92	$231M
9	Orient – Denny - Fairport	$390M
10	Denny – Zachary – Thomas Hill – Maywood	$769M
11	Maywood – Meredosia	$301M
12	Madison – Ottumwa – Skunk River	$673M
13	Skunk River – Ipava	$594M
14	Ipava – Maple Ridge – Tazewell – Brokaw – Paxton East	$572M
15	Sidney – Paxson East – Gilman South – Morrison Ditch	$454M
16	Morrison Ditch – Reynolds – Burr Oak – Leesburg – Hiple	$261M
17	Hiple – Duck Lake	$696M
18	Oneida – Nelson Rd.	$403M
	Total Project Portfolio Cost	**$10.3B**

Costs as of 6/1/2022, and are subject to change (costs represent "overnight" costs)

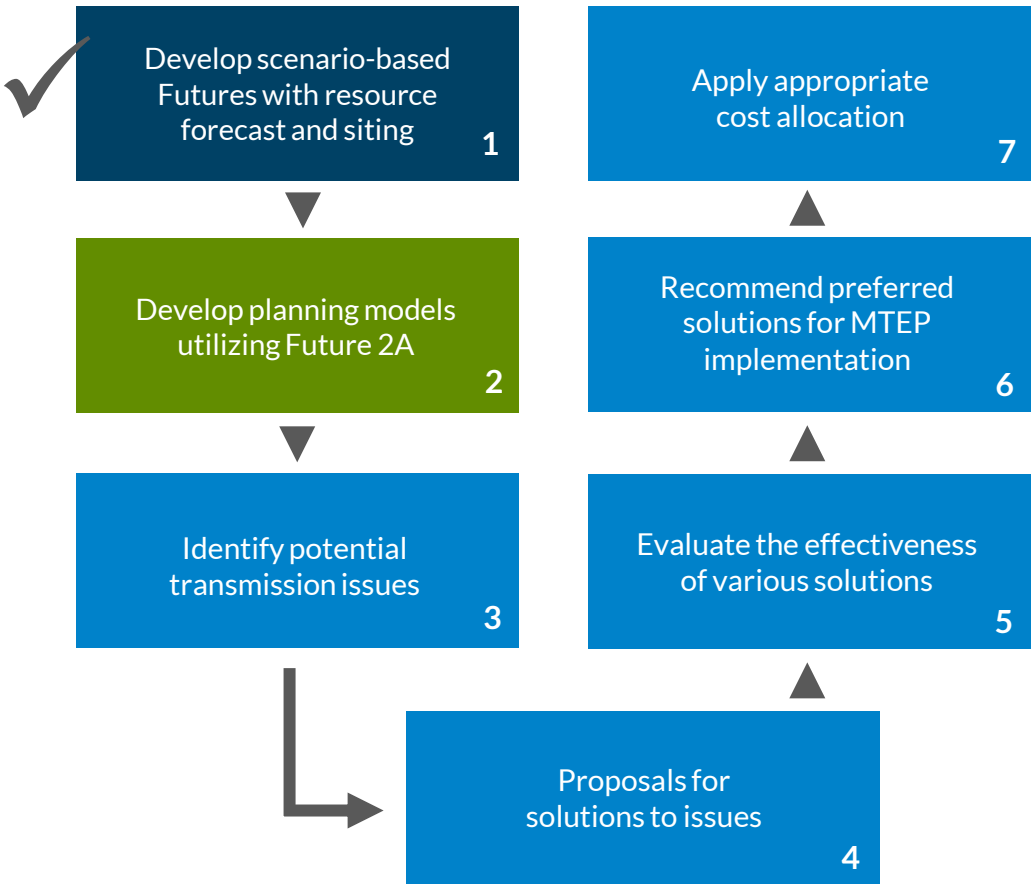
PRELIMINARY JAMESTOWN – ELLENDALE LINE SCHEDULE



Information as of February 2023

Tranche 2 work is progressing with strong stakeholder engagement through meetings, workshops, feedback tools and discussions

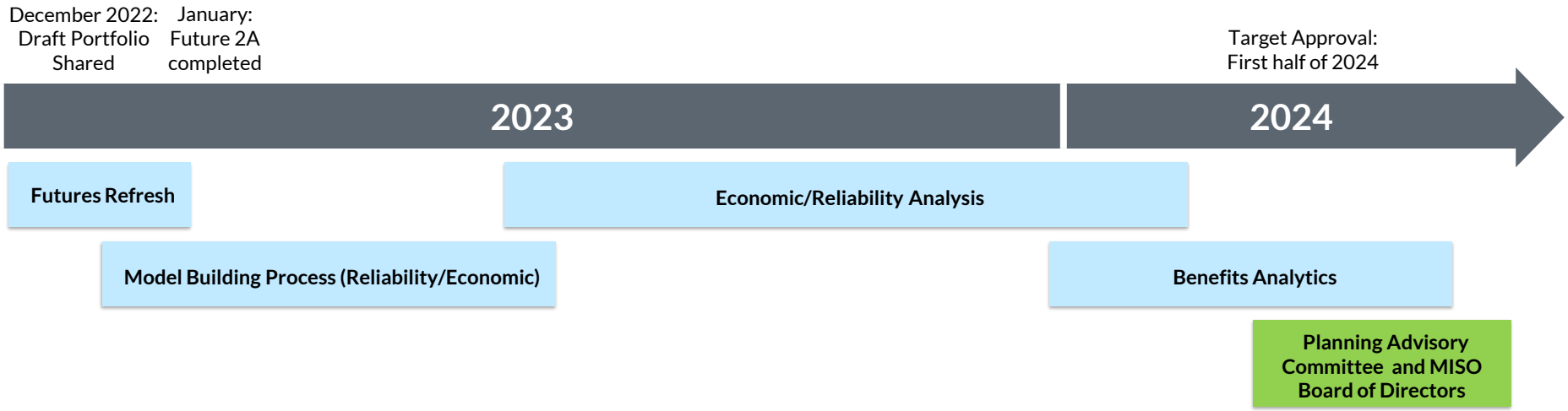
Tranche 2 progress in 7-step process



Significant updates and modifications made based on stakeholder feedback

Complete In Process Not Started

The Tranche 2 schedule will be refined as the process progresses, with model completion targeted for Q3 2023



Stakeholder Process

- Status updates provided at PAC meetings
- Two technical workshops are anticipated to be held per quarter
- Workshops held Q1 and Q2 2023

Q1-Q2 Workshop Topics

- Modeling process
- Analytics process
- Business Case metrics

Q1-Q2 Policy Topics

- Interregional Coordination
- 765 vs 345 kV transmission
- Dispatchable HVDC

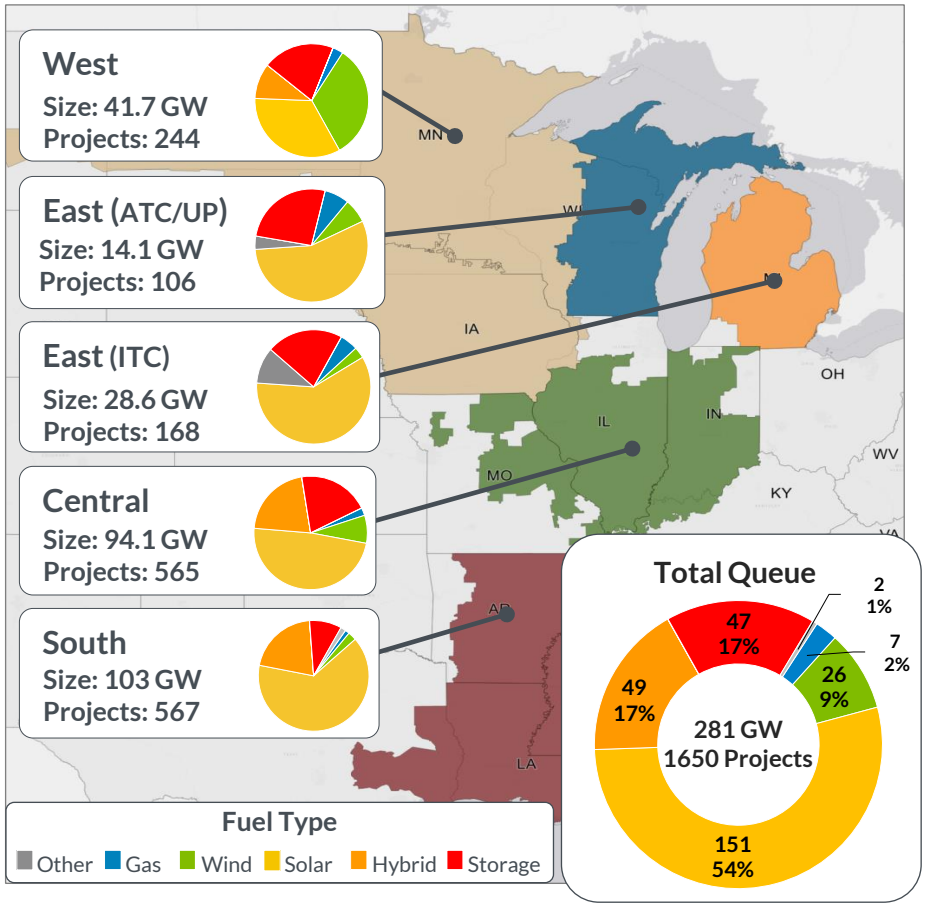
Progress continues to move the SPP-MISO Joint Targeted Interconnection Queue (JTIQ) portfolio to MISO Board approval

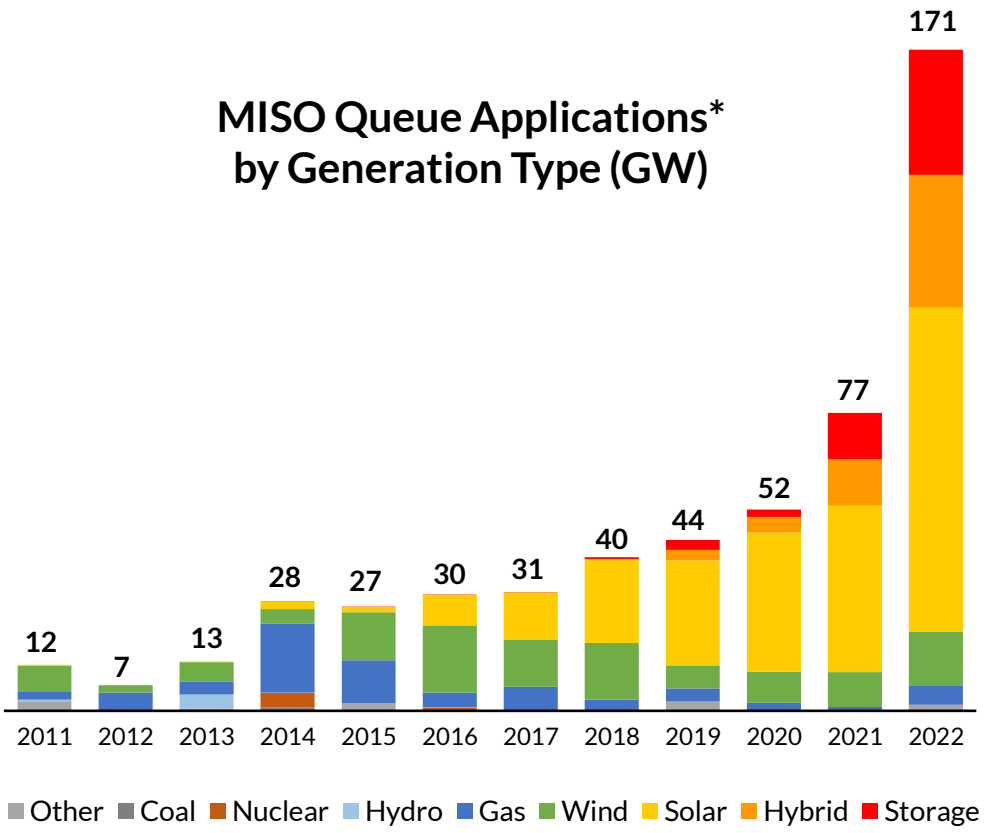
1. Continue progress towards agreement on cost allocation
2. Seek FERC approval of Tariff revisions
3. Update the JTIQ whitepaper
4. Request MISO Board approval

MISO Interconnection Queue

MISO members propose and submit new resource capacity projects to meet changing needs of the system and capitalize on state and federal incentives

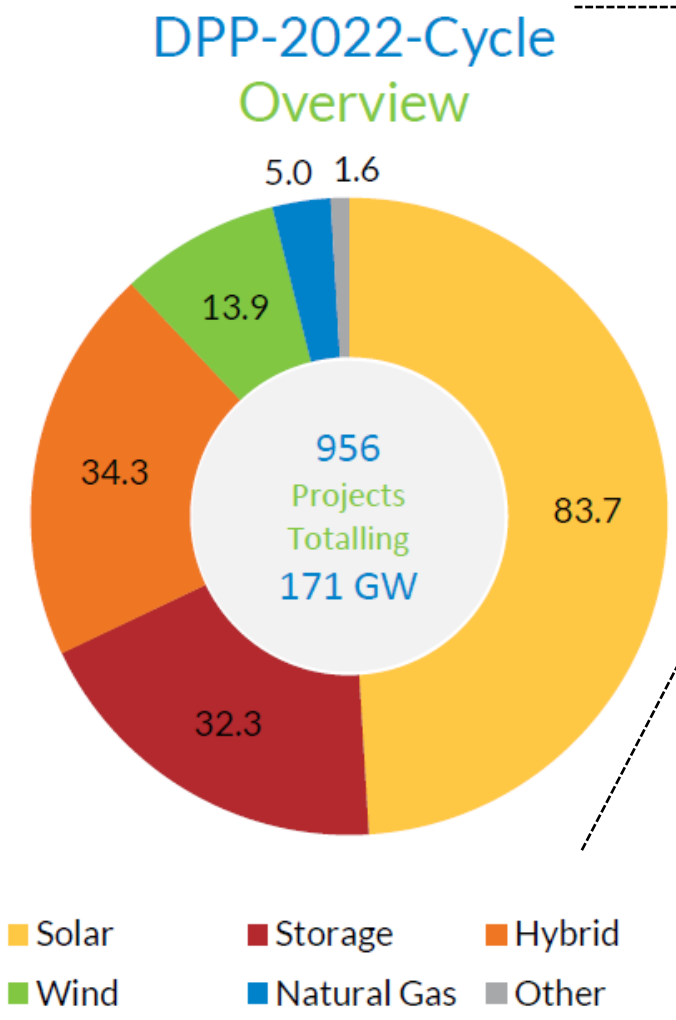
MISO Active Queue plus 2022 Applications





*Not all project applications will enter the active queue. Historically, 10% to 30% have been withdrawn/removed during the application review phase. **Hybrid units represent projects with more than one fuel type

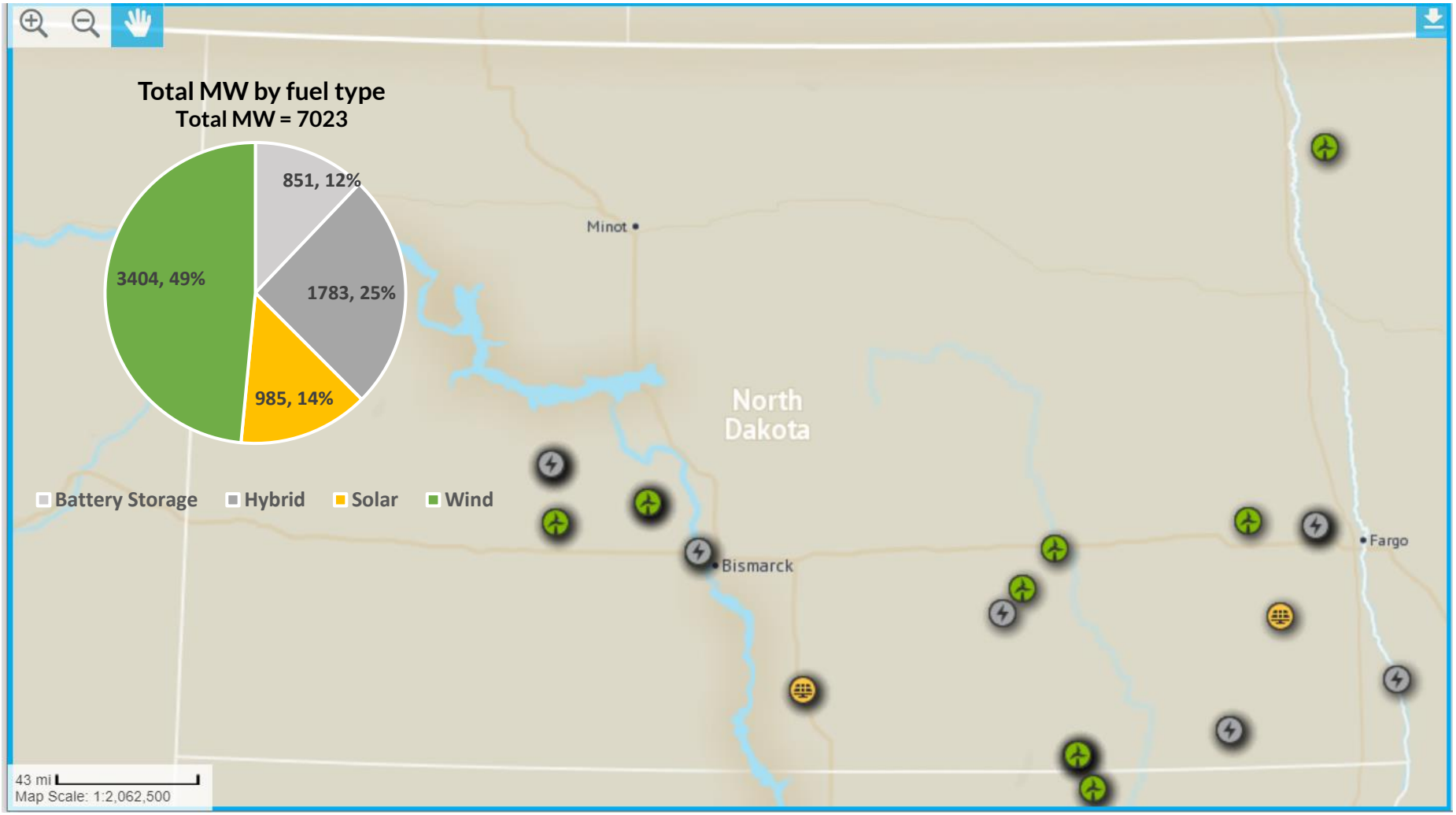
MISO 2022 Interconnection Queue Applications



Total 2022 MISO Queue Interconnection Application Requests			
Fuel	**# of Requests**	**GW**	**%**
Solar	469	83.7	*49*
Storage	231	32.3	*19*
Hybrid	163	34.3	*20*
Wind	66	13.9	*8*
Natural Gas	21	5.0	*3*
Other	6	1.6	*1*
Total	**956**	**170.8**	***100***

North Dakota 2022 Interconnection Application Requests			
Fuel	**# of Requests**	**GW**	**%**
Solar	2	.35	*7.4*
Storage	4	.73	*15.6*
Hybrid	4	1.24	*26.4*
Wind	8	1.83	*39.0*
Natural Gas	1	.54	*11.5*
Other	**0**	0.0	***0***
Total	**19**	**4.69**	***100***

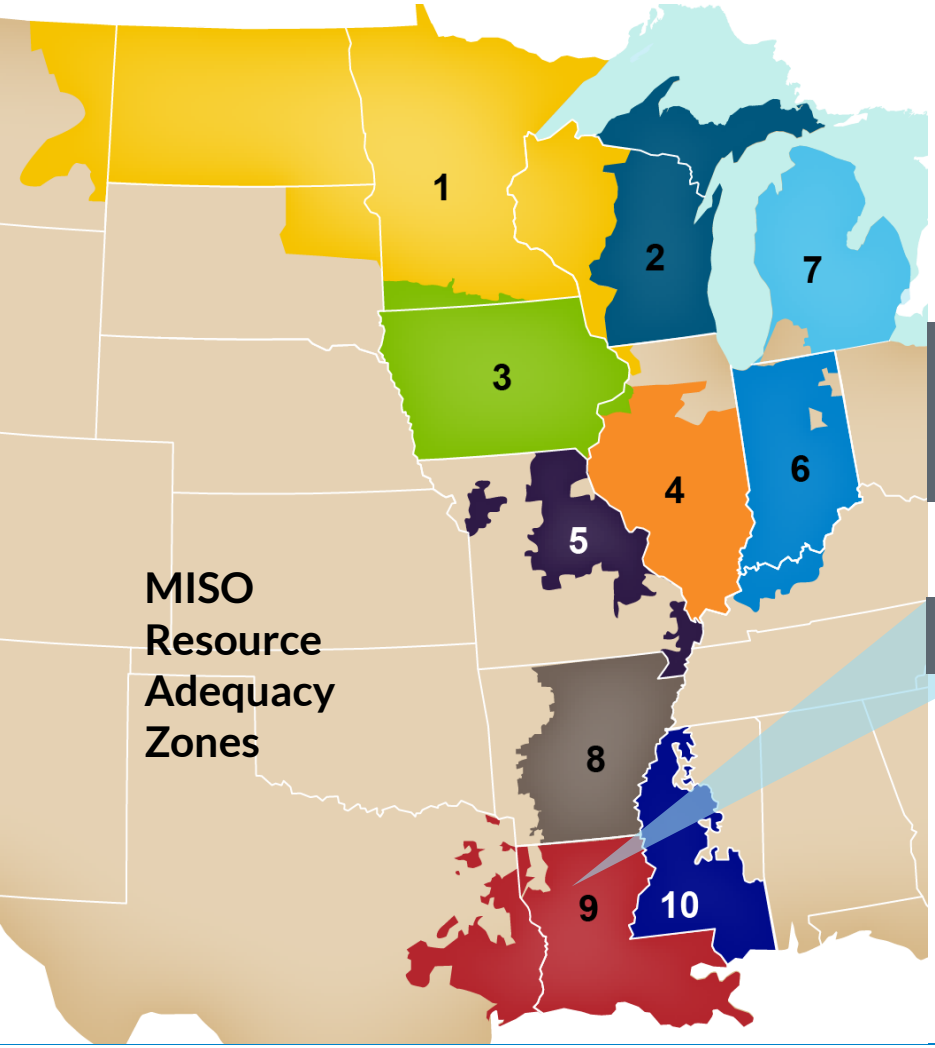
MISO active Generator Interconnection Queue applications in North Dakota



Data as of 7/31/23, project map updated regularly at https://giqueue.misoenergy.org/PublicGiQueueMap/index.html

Organization of MISO States Survey Results

MISO's first seasonal Planning Resource Auction (PRA) demonstrated sufficient capacity for all regions and zones for the entire year



Auction clearing prices were flat across most zones ($/MW/day)

- **Summer: $**10
- **Winter:** $2
- **Fall:** $15
- **Spring:** $10

Except for Zone 9:

- **Fall:** ~$59
- **Winter:** ~ $19

Results of the 2023 OMS-MISO survey reinforce the need for continued reforms to MISO's resource adequacy construct to reliably manage portfolio transition

- Survey responses reflect market actions such as delayed retirements and capacity additions resulting in 1.5 GW of residual capacity for Planning Year (PY) 2024/25
- Without continuing market support and new capacity additions, a capacity deficit of 2.1 GW is projected for the summer of 2025/26 which grows in subsequent years
- Non-summer seasons indicate sufficient, yet declining capacity over the survey horizon
- The North/Central subregion shows an increasing capacity deficit in summer, starting PY 2025/26, while the South region shows increasing tightness and a deficit starting in winter 2027/28
- Demand growth is projected to continue for five years across all four seasons at 0.8 GW or 0.68% per year on average

All presentation references to capacity indicate seasonal accredited capacity (SAC)

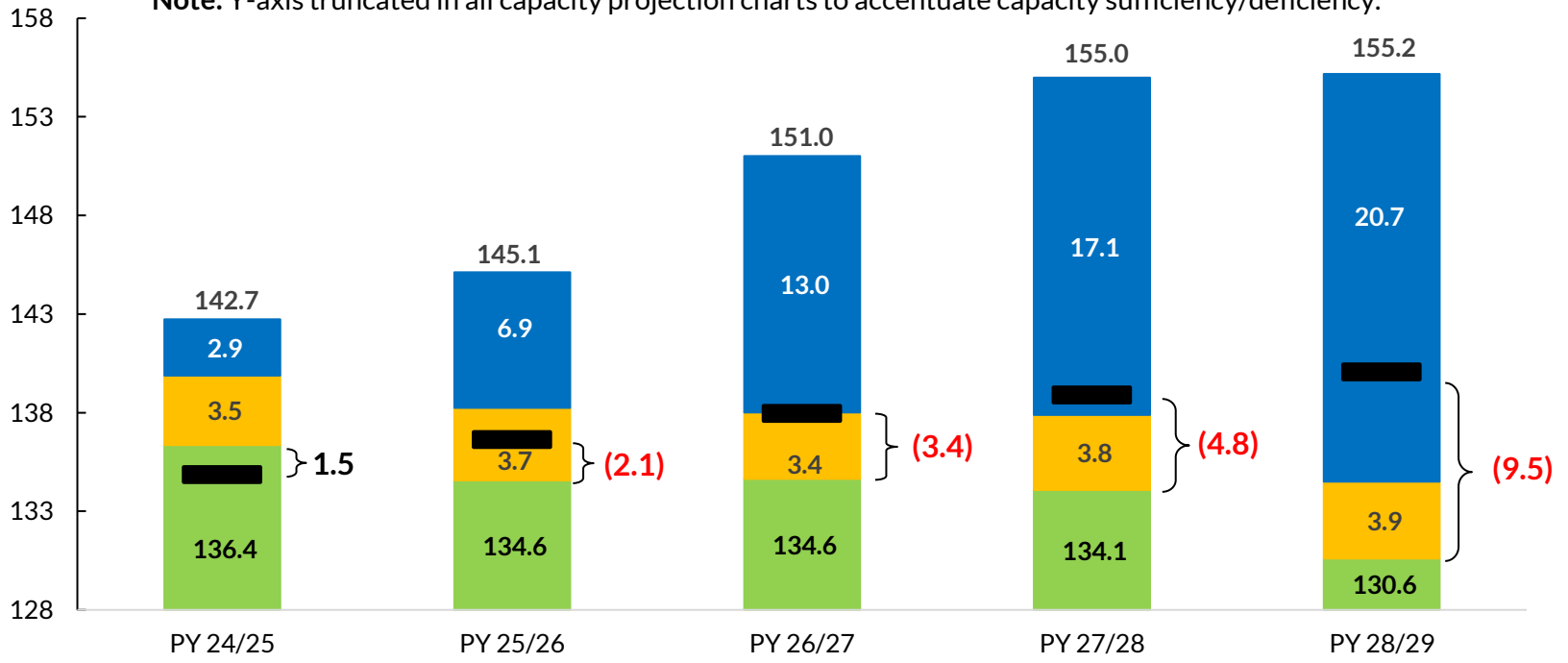
Approximately 90% of existing generation capacity participated in OMS-MISO Survey in 2023. Updated assumptions for representation of future generation from the interconnection queue (October 2022 RASC).

OMS-MISO Survey: Committed capacity shows declines over survey window with potential resource deficits starting in PY 2025/26

Summer Seasonal Accredited Capacity Projections (GW)

2023 OMS-MISO Survey

Note: Y-axis truncated in all capacity projection charts to accentuate capacity sufficiency/deficiency.



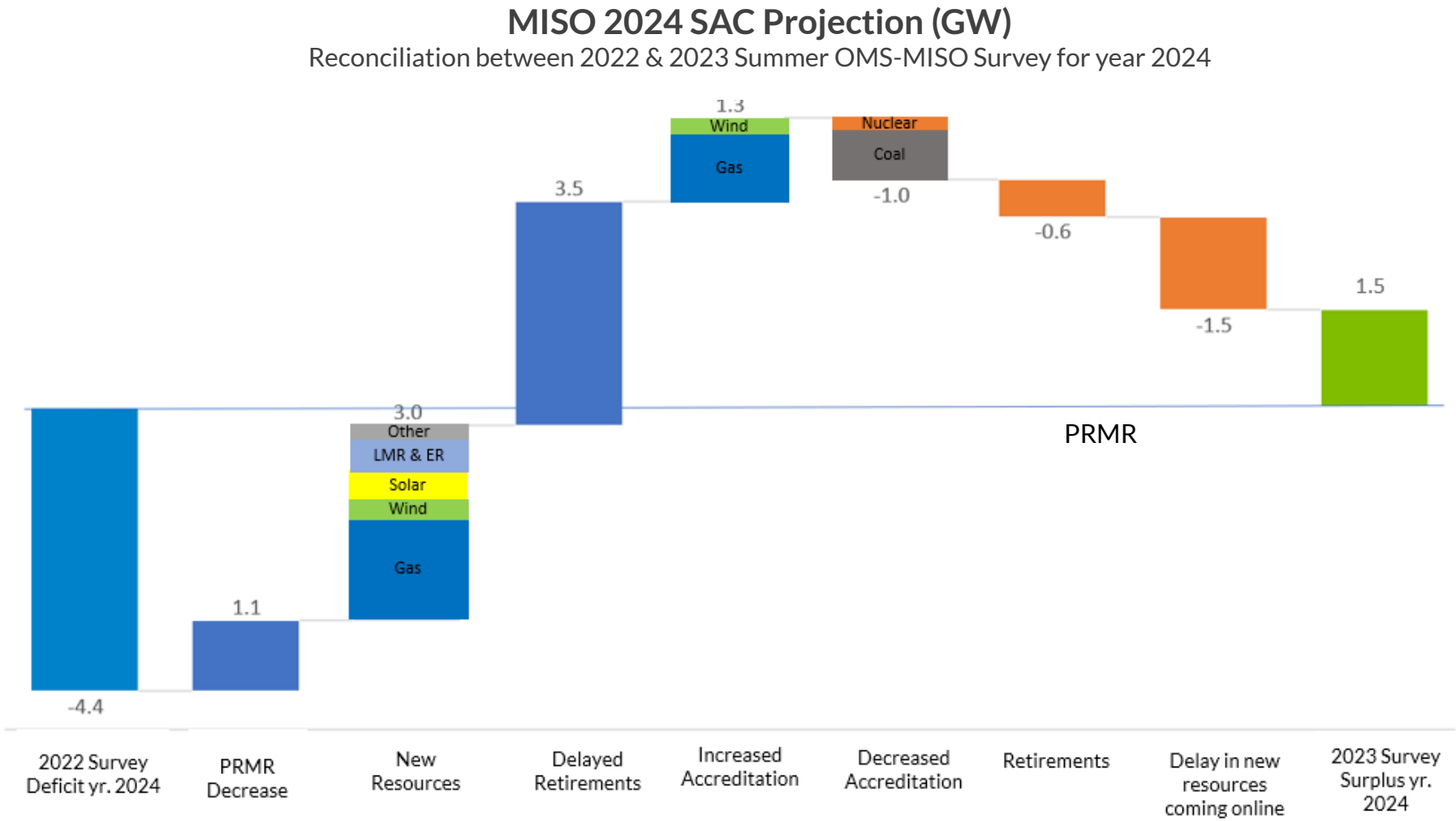
Projected Planning Reserve Margin (PRM)	PY 24/25	PY 25/26	PY 26/27	PY 27/28	PY 28/29
	7.9%	8.3%	8.8%	9.0%	9.2%

Committed Capacity
Potentially Unavailable Resources
Potential New Capacity
Projected PRMR

Bracketed values indicate difference between Committed Capacity and projected PRMR.
Committed Capacity includes signed GIA projects shown on slide 19*.
Capacity accreditation values and PRM projections based on current practices.
Timing/GW of potential New Capacity projected per methodology noted in Oct 2022 RASC.
Regional Directional Transfer (RDT) limit of 1900 MW is reflected in this chart

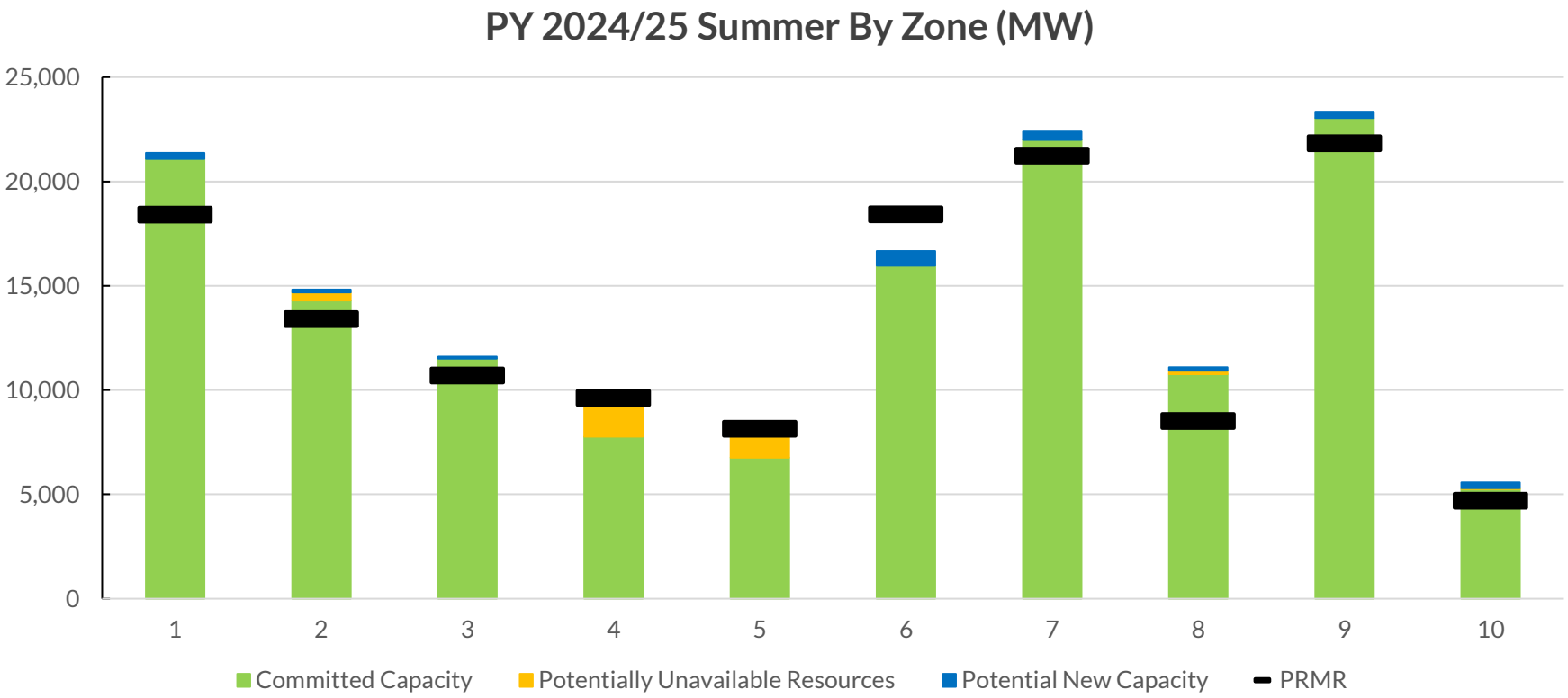
As seen in the materials shared at the OMS-MISO Survey Results Workshop, July 14, 2023

Year-over-year survey results for 2024 show change from deficit to adequate supply due to delayed retirements, new resources and lower load forecast



Lower load forecast noted under 'PRMR decrease'

Zonal view for Summer 2024/25 shows that most zonal PRMRs can be met with resources located within respective zones



 Note: Survey assumes that only resources physically located within the zone will be used to meet the zonal PRMR.

EPA Regulations

MISO is monitoring and assessing multiple EPA regulations

EPA Regulation	Status/Notes
Proposed carbon standards for existing coal and new & modified gas units	• Public comments due August 8 • Final rule target: June 2024
"Good Neighbor" Federal Implementation Plan	• In effect now, but stayed by litigation in multiple MISO states
Coal Combustion Residuals (CCR) Rule	• EPA has proposed to deny compliance applications for multiple plants in the region, including the Rainbow Energy Center
Particulate Matter for the National Ambient Air Quality Standard (NAAQS)	• Nine MISO states filed comments urging EPA to abandon the proposed rule • Final rule target: October 2023
Mercury and Air Toxics Standards (MATS) revisions	• Lignite-fired EGUs would be the most heavily impacted • Final rule target: March 2024
Effluent Limitation Guidelines (ELG)	• EPA forecasts only minor impacts, but some MISO members say otherwise • Final rule target: April 2024
Regional Haze	• EPA behind schedule in reviewing State Implementation Plans (SIPs); environmental groups threatening litigation
Motor vehicle emissions standards	• Designed to increase penetration electric vehicles, driving load growth and potential reliability challenges • Final rule target: March 2024

EPA's carbon standards could have major impacts on the region's coal fleet, with 25 GW subject to CCS or gas co-firing requirements

- EPA's proposed "subcategories" have different compliance requirements based on unit retirement dates and capacity factors

EPA's proposed carbon standards for existing coal		
Proposed subcategory	**Proposed Best System of Emissions Reduction (BSER)**	**Current impact in MISO***
Retire by January 1, 2032	Routine operation and maintenance with no emission rate increase starting January 1, 2030	**~ 28 GW**
Retire by January 1, 2035 and keep capacity factor below 20%	Routine operation and maintenance with no emission rate increase starting January 1, 2030	**0 GW** (with current data, no applicable units)
Retire by January 1, 2040 but no capacity factor limit	Co-fire with 40% gas to reduce emissions rate by 16% starting January 1, 2030	**~ 5 GW**
Continue to operate beyond January 1, 2040	Carbon capture and storage (CCS) with 90% capture of CO_2 starting January 1, 2030	**~ 20 GW**

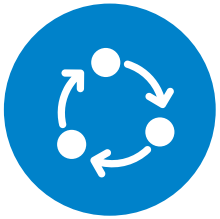
*Note: These figures **only** reflect publicly announced retirements. These units are retiring due to a variety of factors, not just EPA's proposed carbon standards.

Continued collaboration is needed to address the Reliability Imperative

TAKEAWAYS

Capacity Market Improvements
Support for improving pricing in MISO's capacity market

Attributes Development
Support and awareness of wholesale market changes for resource attributes (may affect state and utility resource planning)



Interconnection Queue Reform
Support for efficient queue studies and readiness considerations

Resource Accreditation Reform
Ensuring resources are valued based on availability when needed

Future Outlooks
Collaborating on OMS-MISO Survey, Planning Resource Auctions, Regional Resource Assessments and Futures work

Transmission Permitting and Construction
Timely permitting and development

Questions?